Chapter 5.
Subjects

Topic: *Finding Information

This chapter describes the subjects available in ACIS and related products.

A *subject* is a means by which software items and information are organized to facilitate discussion. Related subjects are gathered into broader categories to allow the user to more easily and logically navigate through the documentation. For example, the subject *Blending* collects together all discussion topics, functions, classes, Scheme extensions, glossary entries, and other information related to performing blends.

Subjects are organized in the following broad groups:

- Getting Started
- Modeling Basics
- Math Elements
- Model Modification
- Analysis
- Model Management
- Display and Input
- Rendering
- Interfaces
- Application Development
- Translators and Converters
- Test Applications
- Deformable Modeling Library

Getting Started

Topic: *Ignore

The following subjects cover topics that help you get started, including some introductions to modeling concepts:

- Finding Information

- Release Notes
- ACIS Overview
- Software Architecture
- Examples
- Creating Entities
- Creating Surfaces
- Creating Solids
- Modifying Models
- Analyzing Models
- Ignore

Finding Information

Topic: Finding Information

Purpose: Documents how information is organized.

Description: This subject compiles all information relating to the ACIS documentation including theory (discussion) topics and reference information.

Release Notes

Topic: Release Notes

Purpose: Presents detailed information about changes in ACIS from the last major release and point releases.

Description: This subject is for convenience. It permits getting to the release notes from the “subject” selection frame.

ACIS Overview

Topic: ACIS Overview

Purpose: Presents overview of ACIS, including modeling concepts.

Description: This subject compiles all information relating to ACIS and geometric modeling concepts and terminology.

Software Architecture

Topic: Software Architecture

Purpose: Presents how the ACIS software is structured.

Description: Refer to Purpose

Examples

Topic: Examples

Purpose: Information about examples, and specific examples of how to do things in ACIS.

Description: Topics in this subject include information about how to find and use examples (mostly Scheme and C++) in the documentation. They also include information about the test applications that serve as example applications, as well as specific examples of functionality.

Creating Entities

Topic: Creating Entities

Purpose: Presents how to create an ACIS entity.

Description: This subject includes items that show how Scheme AIDE can be used to get a jump start in learning about the modeling concepts and implementing functionality in a C++ application. It begins by showing how to create edge entities.

Creating Surfaces

Topic: Creating Surfaces

Purpose: Presents how to create surfaces.

Description: This subject compiles most of the information relating to the creation of the standard ACIS surfaces such as planar faces, cylindrical faces, spherical faces, torus faces, spline faces, and faces using law mathematical functions.

Creating Solids

Topic: Creating Solids

Purpose: Presents how to create solids.

Description: This subject compiles most of the information relating to the creation of ACIS solids such as blocks, cones, cylinders, prisms, pyramids, spheres, tori, and “wiggles.”

Modifying Models

Topic: Modifying Models

Purpose: Presents how to modify an existing model.

Description: This subject compiles most of the information relating to model modification including blending, Booleans, transforms, local operations, shelling, etc.

Analyzing Models

Topic: Analyzing Models

Purpose: Presents how to do geometric analysis and mass properties.

Description: This subject compiles most of the information relating to analysis of geometric models including physical properties, object relationships, geometric analysis, and cellular topology.

Modeling Basics

Topic: *Ignore

The following subjects cover some basic modeling concepts:

- Entity
- Model Object
- Model Topology
- Model Geometry
- Construction Geometry
- Attributes
- Spline Interface
- Tolerant Modeling

Entity

Topic: Entity

Purpose: Provides tools for creating and manipulating entities and model objects.

Description: An entity is the most basic model element that can be saved and restored. This subject groups all of the elements that are used for creating, selecting, and modifying entities.

Model Object

Topic: Model Object

Purpose: Creates an entity having both model geometry and model topology.

Description: This subject compiles all information relating to the creation of a modeling entity that consists of model geometry and model topology and that participates in save, restore, history, and roll.

Model Topology

Topic: Model Topology

Purpose: Defines model boundary representations using bodies, lumps, shells, subshells, faces, edges, coedges, and vertices.

Description: This subject compiles all information relating model topology, the glue that holds a model together. Model topology classes (like FACE) reference model geometry classes (like SURFACE), which then reference the specific information needed for the geometric definition in the construction geometry class (like skin_spl_sur for a skin spline surface).

Model Geometry

Topic: Model Geometry

Purpose: Defines points, curves, pcurves, and surfaces.

Description: The model geometry refers mostly to classes that are derived from ENTITY and reference underlying construction geometry classes. The model topology is the glue that holds the model together and references model geometry items to provide the geometric definition. The specific geometric definitions are typically a layer deeper in construction geometry. For example, the FACE class is part of the model topology. It references the model geometry class called SURFACE. SURFACE references specific construction geometry surface types, such as the offset spline surface, the skin spline surface, etc.

Construction Geometry

Topic: Construction Geometry

Purpose: Presents mathematical definitions of geometry.

Description: This subject compiles the low-level mathematical definitions that are used to describe geometry. These are typically classes that the model geometry references. Construction geometry by itself does not create valid models or anything that can be saved and restored. Valid models have model topology to hold the model together. Model topology classes (like FACE) reference model geometry classes (like SURFACE), which then reference the specific information needed for the geometric definition in the construction geometry class (like skin_spl_sur for a skin spline surface).

Attributes

Topic: Attributes

Purpose: Attaches application data and other data to the model.

Description: This subject compiles all information relating to the attachment of nongeometric data to models.

Spline Interface

Topic: Spline Interface

Purpose: Splines used in ACIS, including the spline interface functions (bs2*, bs3*).

Description: ACIS uses splines to model complex curves, surfaces, and intersections. ACIS provides some functionality for performing direct spline manipulation, such as creating splines, converting entities to splines, etc. However, the *spline interface* (in the Kernel Component) is one of the lowest levels in ACIS, and most applications should not access it directly.

Tolerant Modeling

Topic: Tolerant Modeling

Purpose: Presents a dual architecture to ACIS that permits exact and tolerant modeling.

Description: This subject compiles all information relating to the tolerant modeling. Tolerant modeling permits less precise data to be imported and considered a valid model.

Math Elements

Topic: *Ignore

The following subjects cover topics related to math concepts:

- Mathematics
- Laws
- Transforms
- Graph Theory
- Dimensionality
- Object and Parameter Spaces
- Precision and Tolerance

- Work Coordinate Systems

Mathematics

Topic: Mathematics

Purpose: Presents general mathematics used as the foundation for describing things in 3D.

Description: This subject compiles all information relating to mathematics. Mathematics provides the basic underlying structure for defining things in 3D. This includes SPAposition, SPAvector, SPAmatrix, SPAinterval, etc. Construction geometry is built on top of this to define geometric features.

Laws

Topic: Laws

Purpose: Tools for the law mathematical functions.

Description: This subject compiles all information relating to laws. Laws are mathematical functions that are implemented in a general way in its own subsystem so other functional areas may take advantage of its functionality. Laws can be used for creating and analyzing geometry. They provide MathCAD functionality to ACIS.

Transforms

Topic: Transforms

Purpose: Presents tools for translating, rotating, and scaling.

Description: This subject compiles all of the code elements needed for translating, rotating, and scaling model entities.

Graph Theory

Topic: Graph Theory

Purpose: Provides support technology needed for selective Booleans and sweeping.

Description: This subject compiles the code items needed to support graph theory. Graph theory is the mathematical study about the connectivity of elements. Graph theory is implemented as a general solution in its own subsystem so other functional areas in ACIS, like selective Booleans or sweeping, may take advantage of its functionality.

Dimensionality

Topic: Dimensionality

Purpose: Defines 1D, 2D, and 3D representations and conversions.

Description: Refer to Purpose.

Object and Parameter Spaces

Topic: Object and Parameter Spaces

Purpose: Presents conversions between *xyz* object space and *uv* parameter space.

Description: Parameter space is used to describe or define things on, say, a surface using only two coordinates, *uv*. The surface provides the other boundary data. The parameter coordinates together with the geometry definition of the surface locates the real *xyz* position in 3D.

Precision and Tolerance

Topic: Precision and Tolerance

Purpose: Presents tolerance variables SPAresabs, SPAresnor, and SPAresfit, and their effects on precision.

Description: Refer to Purpose.

Work Coordinate Systems

Topic: Work Coordinate Systems

Purpose: Presents tools for temporary coordinate systems for model creation.

Description: Refer to Purpose.

Model Modification

Topic: *Ignore

The following subjects cover topics related to modifying models:

- Blending
- Booleans
- Covering
- Deformable Surfaces
- Healing

- Intersectors
- Local Operations
- Offsetting
- Projecting
- Shelling
- Skinning and Lofting
- Space Warping
- Stitching
- Sweeping

Blending

Topic: Blending

Purpose: Presents tools for softening sharp edges and corners and creating smooth face–face transitions.

Description: This subject compiles all information relating to blending. Blending operations include chamfer on an edge, constant radius blend on an edge, blend on a vertex, and variable radius blend on an edge.

Booleans

Topic: Booleans

Purpose: Presents operations for unite, subtract, intersect, regularize, imprint, split, slice, and stitch.

Description: This subject compiles all information relating to the Boolean operations of unite, intersect, and subtract that can be performed on ACIS bodies.

Covering

Topic: Covering

Purpose: Presents tools for fitting a surface over a closed loop of curves or wires, where all the boundaries must be specified.

Description: This subject compiles all information relating to generating a face bounded by a closed set of wires.

Deformable Surfaces

Topic: Deformable Surfaces

Purpose: Presents tools for dynamic pulling, stretching, and inflating of surfaces.

Description: This subject compiles all information relating to deformable modeling whereby free–form surfaces and curves can be sculpted interactively.

Healing

Topic: Healing

Purpose: Fixes gaps in the topology and geometry of models.

Description: This subject compiles all information relating to performing healing of model topology and geometry.

Intersectors

Topic: Intersectors

Purpose: Presents information about intersectors that underlie Boolean and other operations.

Description: This subject compiles all information relating to intersectors. Intersectors form an *intersection graph* used by Boolean and other ACIS operations on the model.

Local Operations

Topic: Local Operations

Purpose: Presents tools for moving, tweaking, offsetting, and tapering existing model objects.

Description: This subject compiles all information relating to performing localized operations that minimally affect topology.

Offsetting

Topic: Offsetting

Purpose: Presents tools for offsetting wire bodies.

Description: This subject compiles all information relating to the creation of new wires for faces that have been offset in some manner from a reference wire body or face.

Patterns

Topic: Patterns

Purpose: Facilitating the creation of patterned entities (i.e., entities that are repeatedly copied and transformed, in either a regular or irregular fashion), to enhance the performance associated with such entities, and to compress data.

Description: In solid modeling, a pattern is a repetitive feature or object arranged in a regular manner. Examples of patterns include the radial pattern of holes in a shower head, the linear grating of ventilation holes on a computer monitor, or the treads on a tire. The ACIS pattern functionality provides tools to facilitate the creation and modification of patterns, and to compress the amount of data needed in the SAT file to represent the resulting model.

Projecting

Topic: Projecting

Purpose: Presents tools for projecting objects onto other objects.

Description: Refer to Purpose.

Shelling

Topic: Shelling

Purpose: Presents tools for hollowing a solid.

Description: Shelling is a specialized local operation. It creates a thin-shelled hollow from a solid.

Skinning and Lofting

Topic: *Skinning and Lofting

Purpose: Presents tools for fitting a surface through a series of curves or wires.

Description: Skinning and lofting are related operations. Skinning fits a surface through a series of curves. Lofting also fits a surface through a series of curves, except that the end curves are typically coedges on a face. As such, lofting takes into consideration tangency constraints at the adjoining surfaces.

Space Warping

Topic: *Space Warping

Purpose: Provides a means of warping a model through the use of laws or entity bending.

Description: This subject gathers all of the information relating to warping a model through a controlled operation.

Stitching

Topic: *Stitching

Purpose: Presents tools for joining bodies along edges or vertices.

Description: Refer to Purpose.

Sweeping

Topic: *Sweeping

Purpose: Presents tools for creating objects by sweeping a profile along a path.

Description: Sweeping can create a solid or face. Sweep options specify how the sweep is to be accomplished in 3D.

Analysis

Topic: *Ignore

The following subjects cover topics related to analysis in ACIS:

- Geometric Analysis
- Object Relationships
- Feature Naming
- Physical Properties
- Ray Testing
- Cellular Topology

Geometric Analysis

Topic: Geometric Analysis

Purpose: Performs numerical derivatives, integrals, maximums, minimums, and other calculations on geometric entities.

Description: The geometric analysis capabilities of ACIS are enhanced through the use of graph theory and laws.

Object Relationships

Topic: Object Relationships

Purpose: Presents tools for finding closest point to object and other relationships.

Description: This subject compiles all information relating to the analysis of objects and their relationships.

Feature Naming

Topic: Feature Naming

Purpose: Creates annotation entities which define (in more detail) the results of a modeling operation.

Description: This subject compiles the code elements necessary for feature naming. Feature naming needs to be enabled. When active, it creates annotation entities which can be analyzed to determine in more detail the outcome of a modeling operation. Feature naming is a means to learn how the inputs relate to the outputs of a given modeling operation, such as blending or sweeping. They specify what they are and what related entity created them.

Physical Properties

Topic: Physical Properties

Purpose: Presents tools for mass properties and other physical characteristics.

Description: Refer to Purpose.

Ray Testing

Topic: Ray Testing

Purpose: Used for picking or positional analysis.

Description: This subject compiles all information relating to the use of ray testing. A ray of a specified initial position, direction, and radius can be “fired” to determine the positional relationships of objects.

Cellular Topology

Topic: Cellular Topology

Purpose: Presents tools for internal partitioning of solids for analysis purposes.

Description: Cellular topology can be used as an analysis tool and in assigning properties to specific areas of a model. They are used by graph theory as part of selective Booleans to determine which elements remain after a modeling operation.

Model Management

Topic: *Ignore

The following subjects cover topics related to managing models in ACIS:

- History and Roll
- Part Management

- Persistent ID
- SAT Save and Restore

History and Roll

Topic: History and Roll

Purpose: Presents tools for branched and linear model history undo and redo.

Description: This subject compiles all information relating to the history and roll functionality which permits rapid change between states of an ACIS model.

Part Management

Topic: Part Management

Purpose: Presents tools for implementing a container for model objects.

Description: This subject compiles all information relating to the grouping of entities into parts.

Persistent ID

Topic: Persistent ID

Purpose: Presents tools for attaching identification data to model objects.

Description: Refer to Purpose.

SAT Save and Restore

Topic: SAT Save and Restore

Purpose: Presents tools for writing the model to and reading the model from disk (SAT) files.

Description: This subject compiles all of the code items necessary for understanding SAT files and parsing its data.

Display and Input

Topic: *Ignore

The following subjects cover topics related to graphical interfaces and displaying models:

- Viewing
- Faceting
- Picking
- Rubberbanding
- Grids
- Filtering
- Highlighting
- Colors
- Interactive Hidden Line
- Precise Hidden Line
- Silhouette and Isoparametric Curves
- Text
- Animation

Viewing

Topic: Viewing

Purpose: Presents tools for display of model objects within a window and common interface to all renderers.

Description: Refer to Purpose.

Faceting

Topic: Faceting

Purpose: Presents tools for tessellation of model object surfaces for rendering and other operations.

Description: This subject compiles all information relating to faceting. Faceting generates and controls approximate polygonal representations of a model's surface.

Picking

Topic: Picking

Purpose: Presents tools for mouse- or program-based selection of displayed model objects.

Description: Refer to Purpose.

Rubberbanding

Topic: Rubberbanding

Purpose: Presents tools for dynamic creation, modification, and movement of model objects.

Description: This subject compiles all information relating to rubberbanding. Rubberbanding is used to interactively control the display of a model based on the movements of the mouse.

Grids

Topic: Grids

Purpose: Presents tools for positioning and snapping aid for creation and movement of model objects.

Description: Refer to Purpose.

Filtering

Topic: Filtering

Purpose: Presents tools for selection of model objects based on various criteria.

Description: Refer to Purpose.

Highlighting

Topic: Highlighting

Purpose: Presents tools for color or brightness changes to aid in model object identification.

Description: Refer to Purpose.

Colors

Topic: *Colors

Purpose: Presents tools for colors for wireframe displays.

Description: Refer to Purpose.

Interactive Hidden Line

Topic: Interactive Hidden Line

Purpose: Presents tools for hidden line removal for applications such as drafting.

Description: Used to interactively manipulate hidden lines based on the movements of the mouse.

Precise Hidden Line

Topic: Precise Hidden Line

Purpose: Presents tools for hidden line removal for applications such as drafting.

Description: Refer to Purpose.

Silhouette and Isoparametric Curves

Topic: Silhouette and Isoparametric Curves

Purpose: Presents tools for visualization of curves for wireframe display.

Description: Refer to Purpose.

Text

Topic: Text

Purpose: Presents tools for creating model objects from character strings and fonts.

Description: Refer to Purpose.

Animation

Topic: Animation

Purpose: Presents tools for changing views of the model as a function of time.

Description: Refer to Purpose.

Rendering

Topic: *Ignore

The following subjects cover topics related to rendering (this covers all renderers available in ACIS):

- OpenGL
- Interactive OpenGL
- Rendering Control
- Backgrounds and Foregrounds
- Color Patterns
- Displacement
- Environment Maps
- Image Output
- Lights and Shadows
- Materials
- Ray Tracing

- Reflectance
- Texture Spaces
- Textures
- Transparency

OpenGL

Topic: OpenGL

Purpose: Everything associated with OpenGL rendering.

Description: Refer to Purpose.

Interactive OpenGL

Topic: Interactive OpenGL

Purpose: Interactive interface to space warping using OpenGL rendering.

Description: Refer to Purpose.

Rendering Control

Topic: Rendering Control

Purpose: Rendering modes (Gouraud, Phong, flat, etc.), rendering steps, and how to view.

Description: Refer to Purpose.

Backgrounds and Foregrounds

Topic: Backgrounds and Foregrounds

Purpose: Defines patterns and pictures for rendered image foregrounds and backgrounds.

Description: Refer to Purpose.

Color Patterns

Topic: Color Patterns

Purpose: Defines solid colors and color patterns for rendered images.

Description: Refer to Purpose.

Displacement

Topic: Displacement

Purpose: Defines surface bump mapping for rendered images.

Description: Refer to Purpose.

Environment Maps

Topic: Environment Maps

Purpose: Simulated reflections for rendered images.

Description: Refer to Purpose.

Image Output

Topic: Image Output

Purpose: Presents tools for how a rendered image is sent an output file.

Description: This subject compiles topics such as output display devices, output formats, image conversion for different resolution display devices, and graphics drivers.

Lights and Shadows

Topic: Lights and Shadows

Purpose: Presents tools for lighting the model for rendering and shadow mapping of light blocked by model objects.

Description: Refer to Purpose.

Materials

Topic: Materials

Purpose: Presents tools for attaching color, reflectance, displacement, and transparency to a model object.

Description: Refer to Purpose.

Ray Tracing

Topic: Ray Tracing

Purpose: Presents tools for photo–realistic rendering of reflectance, transparency, and other effects.

Description: Refer to Purpose.

Reflectance

Topic: Reflectance

Purpose: Presents tools for how light bounces off of objects.

Description: Refer to Purpose.

Texture Spaces

Topic: Texture Spaces

Purpose: Simulate image decaling, or carving model objects from a patterned solid.

Description: Refer to Purpose.

Textures

Topic: Textures

Purpose: Wraps bit images around model objects.

Description: Refer to Purpose.

Transparency

Topic: Transparency

Purpose: How light passes though objects (refraction).

Description: Refer to Purpose.

Interfaces

Topic: *Ignore

The following subjects cover topics related to the interfaces to ACIS:

- C++ Interface
- Scheme Interface

C++ Interface

Topic: C++ Interface

Purpose: C++ interface, including classes, API functions, DI functions, etc.

Description: This refers to that which is specific to the C++ language and not ACIS.

Scheme Interface

Topic: Scheme Interface

Purpose: Scheme interface, including the Scheme Interpreter and Scheme utilities, such as system calls, dialog boxes, and journaling.

Description: The Scheme interface refers to things that are specific to the Scheme AIDE application and not ACIS.

Application Development

Topic: *Ignore

The following subjects cover topics related to developing ACIS based applications:

- Building Applications
- Callbacks
- Debugging
- Error Handling
- Extending ACIS
- Memory Management
- Modeler Control

Building Applications

Topic: Building Applications

Purpose: Presents tools and information for building applications with ACIS, including using ACIS libraries.

Description: Refer to Purpose.

Callbacks

Topic: Callbacks

Purpose: Presents tools for notification of changes.

Description: Many events occur during the normal course of modeling operations that may be of particular interest to application development. An example of such an event is when entities are either created or deleted (see entity_callback). ACIS provides several callback mechanisms, which allow customers to “hook“ into the event notification system for special processing purposes. The supplied mechanisms are either function pointers that are registered with register functions or are class objects that are registered in object callback lists.

The Scheme AIDE test application registers input, output, exit callbacks, and provides a good example of the purpose and use of these callbacks.

Debugging

Topic: Debugging

Purpose: Presents tools for debugging methods and model checking.

Description: Refer to Purpose.

Error Handling

Topic: Extending ACIS, Error Handling

Purpose: Error and exception handling.

Description: Refer to Purpose.

Extending ACIS

Topic: Extending ACIS

Purpose: Presents information for extending the functionality of ACIS by deriving classes, adding APIs, adding Scheme extensions, etc.

Description: Refer to Purpose.

Memory Management

Topic: Memory Management

Purpose: Presents information on how ACIS manages memory.

Description: Refer to Purpose.

Modeler Control

Topic: Modeler Control

Purpose: Presents information on controlling the modeler, including initialization, termination, and options.

Description: Refer to Purpose.

Test Applications

Topic: *Ignore

Scheme AIDE is the ACIS demonstration/test application.

Scheme AIDE Application

Topic: Scheme AIDE Application

Purpose: Scheme–based test application used for bug reporting.

Description: The Scheme ACIS Interface Driver Extension (Scheme AIDE) application tests modeling operations. Basic and advanced modeling concepts can be tested without having to code and compile a C++ application. The source code is provided for all Scheme extensions. Therefore, if the modeling operation can be performed in Scheme AIDE, the working C++ prototype code is hence available.

Deformable Modeling Library

Topic: *Ignore

The following subjects cover topics related to the deformable modeling library (DML) used by the ACIS Deformable Modeling Component:

- Deformable Modeling
- Deformable Model Management
- DML Constraints
- DML Create and Query
- DML Graphics
- DML Loads
- DML Patches
- DML Tags

Deformable Modeling

Topic: Deformable Modeling

Purpose: Standalone dynamic pulling, stretching, and inflating of surfaces.

Description: Refer to Purpose.

Deformable Model Management

Topic: Deformable Model Management

Purpose: Management of deformable models.

Description: Refer to Purpose.

DML Constraints

Topic: DML Constraints

Purpose: Creation of constraints for deformable models.

Description: Refer to Purpose.

DML Create and Query

Topic: DML Create and Query

Purpose: Creation of constraints for deformable models.

Description: Refer to Purpose.

DML Graphics

Topic: DML Graphics

Purpose: Creation of constraints for deformable models.

Description: Refer to Purpose.

DML Loads

Topic: DML Loads

Purpose: Creation of loads for deformable models.

Description: Refer to Purpose.

DML Patches

Topic: DML Patches

Purpose: Creation of patches on deformable models.

Description: Refer to Purpose.

DML Tags

Topic: DML Tags

Purpose: Creation of tags for deformable models.

Description: Refer to Purpose.